BONUS ASSIGNMENT
NYA ELECTRO
WINTER 2012

(1) THE VOLTAGE ACROSS A 5μF IS 0. WHAT IS THE VOLTAGE AFTER 20ms IF A 75mA CHARGES THE CAPACITOR.

$$V_c = \frac{1}{C}\int i\,dt$$

$$= \frac{1}{5\mu}\int 75m\,dt$$

$$= \frac{1}{5\mu}\,75m\,t + C$$

WHEN $t=0$ $V_c=0$ $\Longrightarrow$ $C=0$

$$V_c = \frac{1}{5\mu}\,75m\,t$$

$$V_c = \frac{1}{5\mu}\,75m\,(20m) \quad \text{at } t=20ms$$

$$\boxed{V_c = 300\ V}$$

(2) A CERTAIN CAPACITOR HAS 100V ACROSS IT. AT THIS INSTANT A CURRENT OF $i = 0.06t^{1/2}$ IS SENT THROUGH THE CIRCUIT. AFTER 0.25s THE VOLTAGE IS 140V. WHAT IS THE CAPACITANCE?

SOLUTION

$$q = \int i\,dt = \int 0.06t^{1/2}\,dt$$

$$= \frac{0.06t^{3/2}}{3/2} + C_1$$

$$= 0.04t^{3/2} + C_1$$

$$V = \frac{1}{C} q$$

$$= \frac{1}{C} \int i \, dt$$

$$V = \frac{1}{C}(0.04t^{3/2} + C_1) \qquad 100 = \frac{1}{C}(C_1) \quad \text{EQUN 1}$$

$$140 = \frac{1}{C}(0.04\,(0.25)^{3/2} + C_1) \quad \text{EQUN 2}$$

Solve for C:

$$140 = \frac{0.04(0.25)^{3/2}}{C} + \frac{C_1}{C}$$

$$140 - 100 = \frac{0.04(0.25)^{3/2}}{C}$$

$$C = \frac{0.04(0.25)^{3/2}}{40} = \boxed{125\,\mu F}$$

(3) The charging voltage for a capacitor is given by $V = 0.25t^2 - 2t + 5$ volts. Determine the amount of max min charge & the time at which it occurs, given $C = 0.1\,\mu F$

$$V = 0.25t^2 - 2t + 5$$

$V = \frac{q}{C}$ so $q = CV$

$= 0.1\mu(0.25t^2 - 2t + 5)$

$q' = 0.1\mu(0.5t - 2)$

critical point $\rightarrow$ $t = 4s$

	$(-\infty, 4)$	$(4, \infty)$
Test pt	0	5
Sign q'	$-$	$+$
q inc/dec	$\searrow$	$\nearrow$

q is a minimum at $t = 4s$

$q = 0.1\mu(0.25(4)^2 - 2(4) + 5)$

$= 0.1\mu(1)$

$= \boxed{0.1\mu C}$